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CHAMPION INTERNATIONAL CORPORATION
HAMILTON, OHIO

## I. SUMMARY

In July, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate the noise levels found in the small cutter area of Champion International Corporation's paper mill located in Hamilton, Ohio. Workers were concerned that one particular paper cutter in the small cutter area was much louder than the other cutters in the area and that a hazard to their hearing existed. During the opening conference of the health hazard evaluation, it was discovered that the company had already fabricated an enclosure for the rotary knife blade of the paper cutter in question and was planning to install it. It was agreed to measure the sound from the machine both before and after the installation of the enclosure.

Noise surveys were conducted in July and November, 1986, to investigate the effects on the noise levels from the enclosure which was installed between the two survey dates. Area sampling was performed with a stationary GenRad Model 1982 Precision Sound Level Meter with octave band capabilities mounted on a tripod. The personal noise dosimetry used Metrosonic Model db-301 Metrologgers which were worn by the paper cutter operators throughout the entire work shift. Microphones from the Metrologgers were located on the workers' shirt collars.

The results of the area noise sampling showed a noise reduction of 13 decibels on the A-weighted slow weighting network (dB(A)) as a function of the knife blade enclosure, going from values of 108 dB(A) prior to installation to 95 dB(A) after enclosing the blade. However, the personal noise dosimetry results showed little change from the pre-enclosure to post-enclosure sampling period. The eight hour Time Weighted Average (TWA) values ranged from 85 to 91 dB(A) during the July survey and from 86 to 92 dB(A) during the November noise survey. This apparent paradox was partially explained to be the result of different operators or different weights of paper. It does, however, point out the difference between noise exposures to workers and noise levels being emitted by machinery.

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A noise hazard was found to exist in the small cutter area of the paper mill. The potential for excess noise exposure was reduced by enclosing the rotary knife blade, however eight-hour TWA values in excess of 85 dB(A) were common in the area even after the blade was enclosed. Recommendations to further reduce the noise hazard and to protect the workers' hearing are provided in Section VIII of this report.

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KEYWORDS: SIC 2645 (Die-Cut Paper and Paperboard and Cardboard), noise, paper making industry, paper cutters, enclosures.

## II. INTRODUCTION

In July, 1986, NIOSH received a request to investigate the noise levels found in the small cutter area of Champion International Corporation's Hamilton, Ohio mill operations. Workers were concerned about the high noise levels found in this area of the paper mill and the possibility of hearing loss. The concern seemed to focus on one particular paper cutter, a Clark-Aiken 76" wide cutter with a 25" diameter rotary knife blade. The cutter had been previously redesigned to allow faster paper cutting speeds to be obtained with this machinery. Shortly after the change, the company began to receive complaints about the noise levels in the small cutter area. Because of this, the corporation's engineers designed an enclosure to be put around the rotary blade in an attempt to reduce the noise levels from the cutter. It was decided that NIOSH would conduct a noise survey of the small cutter area in two phases. The first phase would incorporate both area and personal sampling of the small cutter area before the enclosure was put into place. The second phase would repeat the earlier sampling procedures after the company had put the enclosure on the Clark-Aiken paper cutter. NIOSH provided Champion International Corporation and the requestor interim reports with the noise sampling results in August, 1986 and December, 1986.

## III. BACKGROUND

An earlier NIOSH study investigating noise levels in the paper making industry [1] had found mean noise intensity levels of 91.4 dB(A) for the paper cutters surveyed. This same study also showed that workers who were classified as having jobs where the noise levels exceeded 89 dB(A) exhibited a growth in hearing loss as a function of the age of the worker. The kinds of paper cutters surveyed in this earlier study were of similar design and operation as the machines located in the small cutter area of Champion International.

The Hamilton, Ohio mill produces paper from pulp at this facility. Much of the production is converted into several different kinds of finished paper products which are shipped to customers. One of the converting processes is the cutting of sheets according to customer specifications from the large rolls of paper manufactured at this location. The paper cutter machine of concern is one of seven cutters located in a row in an enclosed part of the paper mill. Two single operator paper cutters are located on either side of the two operator Clark-Aiken cutter. Located directly behind the row of cutters is a storage area where rolls of paper produced elsewhere in the paper mill are kept until needed for upcoming customer orders. Behind the roll storage area is a calendar operation where there are located 3-5 calendar machines. These machines were in operation during the time periods when noise sampling was conducted. In front of the row of paper cutters is an aisle way for lift truck traffic and a cement block dividing wall.

The Clark-Aiken cutter operates by feeding paper from rolls through the cutter and under a rotary knife blade which is attached to a cylinder. The cylinder is hollow and is driven by a series of metal and fiber gears located on the side of the machine. The sheets of cut paper are transferred to a skid by means of a moving belt system. The rotary knife blade enclosure which had been fabricated by the engineering department of Champion International was composed of No. 16 gauge aluminum sheet metal with the inside area of the top and sides having 2" acoustical foam glued to it. The enclosure covered the entire top half of the knife blade as well as extending down 6" below the center line in the front of the knife cylinder. The prefabricated enclosure was installed by the mill's maintenance personnel following the July noise survey.

## IV. EVALUATION DESIGN AND METHODS

Seven individuals within the small cutter area of the mill were chosen to wear personal noise sampling devices for two consecutive work days. The seven workers included the two operators from the high speed paper cutter involved in the enclosure installation (paper cutter #20), the two cutter operators who had to work directly next to and on either side of the noisier cutter (paper cutters #19 and #22, respectively), the crane operator who furnished rolls of paper to the cutter of concern, and two cutter operators from the high speed cutter (paper cutter #15) located on the end of the row of cutters approximately 100-150 feet from the Clark-Aiken cutter. This sampling strategy was used for both the July and November noise surveys. However, the company's rotating shift schedule was such that different workers were tested during the two survey periods.

The personal noise measurements were taken with Metrosonics Model 301-db Metrologgers with 1/8" remote microphones which were clipped to the shirt collars of the tested workers. These noise samples were collected over the entire eight hour work shift or as long as the worker was at his work station. The dosimeters were not taken off during the lunch period. Noise data collected with the Metrologgers were analyzed with a Metrosonics Model 653 Metroreader. The Metroreader also allowed for the storage of the data onto magnetic tape.
Additional area noise measurements were obtained with a GenRad Model 1982 Precision Sound Level Meter which had been mounted on a tripod. This sound level meter has octave band measurement capabilities as well as the A, B, C, and "flat" weighting networks. The area measurements were taken at exact locations around the Clark-Aiken paper cutter so that the post enclosure readings would be comparable to the earlier readings. All sound survey equipment was calibrated before and after samples were taken according to manufacturers' instructions with traceable calibration sources from the National Bureau of Standards.

## V. EVALUATION CRITERIA

Exposure to high levels of noise may cause temporary or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence[2,3] that protracted noise exposure above 90 dB(A) causes hearing loss in a portion of the exposed population.

The Occupational Safety and Health Administration's (OSHA) existing standard for occupational exposure to noise (29 CFR 1910.95)[4] specifies a maximum permissible exposure level (PEL) of 90 dB(A)-slow response for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be exposed to noise levels of 95 dB(A), the amount of time allowed at this exposure level must be cut in half in order to be within OSHA's PEL. Conversely, a person exposed to 85 dB(A) is allowed twice as much time at this level (16 hours) and is within his daily PEL. Both NIOSH, in its Criteria for a Recommended Standard[5], and the American Conference of Governmental Industrial Hygienists (ACGIH), in its Threshold Limit Values (TLVs)[6], propose an exposure limit of 85 dB(A) for 8 hours, 5 dB less than the OSHA standard. Both of these latter two criteria also use a 5 dB time/intensity trading relationship in calculating exposure limits.

Time-weighted average noise limits as a function of exposure duration are shown as follows:

| Duration of Exposure (hrs/day) | Sound Level (dB(A)) NIOSH/ACGIH | OSHA |
|---|---|---|
| 16 | 80 | 85 |
| 8 | 85 | 90 |
| 4 | 90 | 95 |
| 2 | 95 | 100 |
| 1 | 100 | 105 |
| 1/2 | 105 | 110 |
| 1/4 | 110 | 115 * |
| 1/8 | 115 * | - ** |

* No exposure to continuous or intermittent noise in excess of 115 dB(A).

** Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

The OSHA regulation has an additional action level (AL) of 85 dB(A) which stipulates that an employer shall administer a continuing, effective hearing conservation program when the TWA value exceeds the AL. The program must include environmental monitoring, employee notification, observation, an audiometric testing program, hearing protectors, training programs, and recordkeeping requirements. All of these stipulations are included in 29 CFR 1910.95, paragraphs (c) through (o).

When workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels. Also, a continuing, effective hearing conservation program shall also be implemented.

## VI. RESULTS AND DISCUSSION

During the July noise survey, on the first day of sampling, all of the paper cutters were in operation. However, on the second day of sampling, the Clark-Aiken cutter tore apart one of its fiber gears and thus did not operate for most of the eight hour shift. This serendipitous occurrence allows one to view the noise effects of this particular paper cutter on the entire cutter area. Because of this happening, the sampling results from both survey periods are presented separate by day. All machines were in operation during the post enclosure survey period.

The results of the area sampling are given in Table 1. The July data showed A-weighted values of 108 dB(A), while the octave band analysis demonstrated that the majority of the sound energy was in the mid-frequency range from 250 to 4,000 Hertz (Hz). The November results, however, were on the order of 95 dB(A) with a corresponding reduction in the mid-frequency sound intensities. These two sets of noise data were taken in the exact same location around the Clark-Aiken paper cutter. The paper's basis weight was different during the two measurement periods. The thickness of the paper is reflected in the basis weight with the thicker paper having a greater basis weight. The weight was 146 lbs during the July noise survey and only 119 lbs during the November measurement period.

However, this difference was partially compensated by the fact that two rolls of the 146 lbs paper were being cut simultaneously in July, while three rolls of 119 lbs paper were cut at one time in November.

Table 2 contains the results from the four days of personal noise dosimeter sampling from the two measurement periods. As was stated earlier, it should be noted that the paper cutter #20 did strip one of its drive gears on the second day of the July survey and, therefore, did not operate for most of the work shift. During the July measurement, the noise dosimeter TWA values for the first day ranged from 86 to 91 dB(A). However, the results from day two exhibit a consistent 2 to 3 dB(A) reduction in the TWA results. Thus, it did appear from these findings that the Clark-Aiken paper cutter did influence the noise environment of the small cutter area when it was in operation. After the installation of the rotary knife blade enclosure, the November noise survey was conducted. The TWA values recorded during both days of the second survey were similar to the first day of measurements obtained in July. They range from 86 to 92 dB(A). When one looks at a comparison of the first days of the two surveys, then it is seen that five of the seven TWA values recorded were less following the installation of the cylinder enclosure. But the reduction in the dosimeter values is not nearly of the same magnitude as the results observed when the stationary sound level meter was used.

This apparent discrepancy in noise values points out the need to be careful when describing the noise levels found in a work area as opposed to the noise exposures accrued by a worker. The levels of noise produced by this particular paper cutter were reduced substantially by enclosing the knife blade with the cylinder guard.

The 13 dB(A) reduction represents approximately a fivefold change in level because of the mathematics involved in using a logarithmic scale (decibels). However, the workers' noise exposures remained nearly the same. The TWA values were either 90 or 91 dB(A) on the days that the cutter was operating, regardless of whether the cylinder guard was in place or not. These findings do not mean that the enclosure was ineffective. The potential for noise overexposure to the workers operating this particular cutter and the workers in the immediate area has been reduced. It must be remembered that these noise sampling results were taken at different times, with different cutter operators, doing different cutting operations on different kinds of paper. These latter variables have to be figured into the "exposure equation" as well as just the noise level variable. The fact that 5 of the 7 dosimeter readings on the first day of the November sound survey were less than the TWA values obtained prior to installation of the cylinder guard shows how the change in one paper cutter affected the entire row of paper cutters. One additional benefit of the installation of the cylinder guard is that an exposed rotary knife blade is now covered, reducing the possibility of accidents and injuries.

## VII. CONCLUSIONS AND RECOMMENDATIONS

A noise hazard was found to exist in the small cutter area of the mill. Even though the cylinder enclosure was found to be effective in reducing the noise level of the Clark-Aiken paper cutter, the overall exposure values obtained during the noise surveys were consistently in excess of 85 dB(A). Documented noise exposures of this magnitude are regulated by OSHA's Hearing Conservation Amendment found in 29 CFR 1910.95. The noise exposures in excess of 90 dB(A) are in excess of the OSHA PEL for noise. All noise measurements were in excess of the NIOSH Recommended Exposure Limit and the ACGIH TLVs.

Based upon the data obtained in this evaluation, we recommend that:

1. Champion International continue to pursue engineering controls which can be added to this paper cutter to help further reduce the noise levels produced by its operation. This could include the use of nonmetallic drive gears which would reduce the "clanging" sound heard in the cutter. Also, the filling of the hollow knife blade cylinder with a lightweight acoustical material may help to reduce the resonance phenomenon noted during the November survey. The hollow cylinder seemed to amplify the clanging sound produced by the drive gears.

2. The use of the in-house designed rotary blade enclosure should be pursued for other machines of the same type which will further reduce the noise levels found around these paper cutters.

3. An effective hearing conservation program should be aggressively pursued by by company. One person should be put in charge to oversee the various aspects of the program to make sure that all portions of the program are being put into operation.

4. The use of hearing protection devices (HPDs) should be expanded to include all people who have reason to be in the small cutter area. This should include workers, supervisory personnel, and anyone else who visits the area, regardless of the time spent in the location.

5. Retraining of personnel in the proper use of HPDs is warranted. During the evaluation, it was noted several times that workers were not properly inserting their HPDs. In one instance, an E A R acoustical foam plug was observed in a worker's ear in a sideways position. This worker was receiving very little, if any, attenuation from this earplug.

6. Reevaluation of this paper cutter and any other paper cutter should be conducted following any changes in the equipment or in the work practices used in operating the equipment to ascertain if the noise levels and/or exposures have changed also.

## VIII. REFERENCES


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## IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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1. Champion International Corporation, Hamilton, Ohio.
2. Requestors
3. U.S. Department of Labor - OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

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TABLE 1

Area Sound Level Measurements Taken Near Clark-Aiken Paper Cutter
(all values are reported in decibels)

| | OCTAVE BANDS (kHZ) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.03 | 0.06 | 0.12 | 0.25 | 0.50 | 1.00 | 2.00 | 4.00 | 8.00 | C-wgt | A-wgt |
| *(1) | 85 | 88 | 90 | 97 | 101 | 97 | 100 | 96 | 91 | 106 | 105 |
| *(2) | 85 | 87 | 91 | 99 | 102 | 102 | 104 | 99 | 94 | 109 | 108 |
| *(3) | -- | 79 | 81 | 87 | 92 | 88 | 91 | 83 | 78 | --- | 95 |
| *(4) | -- | 78 | 83 | 88 | 94 | 89 | 91 | 84 | 80 | --- | 95 |

*Conditions:

(1) July, 1987; Cutter operating with no paper, 740 feet per minute;

(2) July, 1987; Cutter operating with paper, 740 feet per minute;
paper's basis weight = 146 lbs.

(3) Nov., 1987; Cutter operating with paper, 650 feet per minute;
paper's basis weight = 119 lbs.

(4) Nov., 1987; Cutter operating with paper, 740 feet per minute;
paper's basis weight = 119 lbs.

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TABLE 2

Personal Noise Dosimeter Results from Small Cutter Area
(all values are reported in dB(A) as 8-hour TWA's)

| | July Survey | | November Survey | |
|---|---|---|---|---|
| JOB LOCATION | Day 1 | Day 2 | Day 1 | Day 2 |
| paper cutter #15 | 87.0 | 84.7 | 85.9 | 86.4 |
| paper cutter #15 | 89.7 | 87.7 | 87.6 | 86.1 |
| paper cutter #19 | 89.8 | 87.7 | 88.8 | 87.4 |
| paper cutter #20 | 90.3 | 86.9 | 91.6 | 90.8 |
| paper cutter #20 | 91.2 | 87.9 | 90.4 | 89.8 |
| paper cutter #22 | 90.9 | 88.3 | 87.3 | 88.0 |
| crane operator | 86.4 | 86.1 | 87.2 | 90.8 |